DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 26 May 2008 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 1-3, 5-7, 11-13, 15, 18-21, 23-26, 30-32, 34, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kubby (US 5,706,041) in view of Moon et al. (US 2002/0054191 A1).

With respect to claim 1, Kubby discloses an ink jet printhead (Column 1, line 10) comprising:

- a plurality of nozzles (Column 1, line 10);

- a heater (Fig. 4, element 18) associated with each of the nozzles respectively, the heater having a heater element and a pair of electrodes (Fig. 1, element 24; Column 3, lines 61-64, Column 4, lines 40-43, i.e. conductive traces),
- the heater element configured for thermal contact with a bubble forming liquid (Column 3, lines 64-67; Column 4, lines 1-4) and
- the electrodes configured for connection to an electrical power source (Column 1, line 20, i.e. digital signal); such that, heating the heater element above the boiling point of the bubble forming liquid forms a gas bubble that causes the ejection a drop of ejectable liquid from the nozzle (Column 1, lines 17-30);
- wherein the heater is formed by layers of material (Column 3, lines 64-67; Column 4, lines 1-4), such that the heater element and electrodes are formed of a material (Column 3, line 50 – Column 4, line 55), a first layer (Fig. 4, element Poly 1) of the single material heater layers having the heater element (Fig. 4, element 20a) and a second layer (Fig. 4, element Poly 2) of the single material heater layers overlaying and spaced from (Fig. 4, SiN_3, oxide) the first layer not having the heater element (Fig. 4, element 20b, i.e. thermistor; Column 4, lines 52-55).

With respect to claim 2, Kubby discloses the layers of heater material (Fig. 2, elements 20 and 22) forming the element and the electrodes (Fig. 1, element 24) are spaced apart (Column 3, lines 61-64).

With respect to claim 3, Kubby discloses the element (Fig. 1, element 18) has two layers of heater material (Fig. 2, elements 20 and 22) and the electrodes have three layers (Fig.1, element 24, Column 3, lines 54, 61-64) of heater material.

With respect to claim 5, Kubby discloses the bubble forming liquid and the ejectable liquid are of a common body of liquid (Column 1, lines 17-30).

With respect to claim 6, Kubby discloses a page-width printhead (Column 14-16).

With respect to claim 7, Kubby discloses each heater element is in the form of a cantilever beam (Column 1, line 66-67, i.e. suspending the heater chips).

With respect to claim 11, Kubby discloses each heater element has two opposite sides and is configured such that a said gas bubble formed by that heater element is formed at both of said sides of that heater element (Column 1, lines 64-67; Column 2, lines 1-16; Column 4, lines 56-66).

With respect to claim 12, Kubby discloses the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element (Column 1, line 27, i.e. nucleation).

With respect to claim 13, Kubby discloses a structure that is formed by chemical vapor deposition (CVD), the nozzles being incorporated on the structure (Column 3, lines 31-35; Column 5, lines 41-49, i.e. conventional CMOS processing).

With respect to claim 15, Kubby discloses a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed

on different respective layers (Fig. 1, elements 20 and 24) to one another (Column 1, lines 17-30).

With respect to claim 18, Kubby discloses each heater element is substantially covered by a conformal protective coating (Fig. 3, element Si_3N_4), the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless (Column 4, lines 38-43).

With respect to claim 19, Kubby discloses a printer system (Column 1, line 6), which incorporates a printhead (Column 1, line 5), the printhead comprising:

- a plurality of nozzles (Column 1, line 10);
- a heater (Fig. 4, element 18) associated with each of the nozzles respectively, the heater having a heater element and a pair of electrodes (Fig. 1, element 24; Column 3, lines 61-64, Column 4, lines 40-43, i.e. conductive traces),
- the heater element configured for thermal contact with a bubble forming liquid (Column 3, lines 64-67; Column 4, lines 1-4) and
- the electrodes configured for connection to an electrical power source (Column 1, line 20, i.e. digital signal); such that, heating the heater element above the boiling point of the bubble forming liquid forms a gas bubble that causes the ejection a drop of ejectable liquid from the nozzle (Column 1, lines 17-30);
- wherein the heater is formed by layers of material (Column 3, lines 64-67; Column 4, lines 1-4), such that the heater element and electrodes are formed of a material (Column 3, line 50 – Column 4, line 55), a first layer (Fig. 4, element Poly 1) of the single material heater layers having the heater element (Fig. 4,

element 20a) and a second layer (Fig. 4, element Poly 2) of the single material heater layers overlaying and spaced from (Fig. 4, SiN_3, oxide) the first layer not having the heater element (Fig. 4, element 20b, i.e. thermistor; Column 4, lines 52-55).

With respect to claim 20, Kubby discloses the layers of heater material (Fig. 2, elements 20 and 22) forming the element and the electrodes (Fig. 1, element 24) are spaced apart (Column 3, lines 61-64).

With respect to claim 21, Kubby discloses the element (Fig. 1, element 18) has two layers of heater material (Fig. 2, elements 20 and 22) and the electrodes have three layers (Fig.1, element 24, Column 3, lines 54, 61-64) of heater material.

With respect to claim 23, Kubby discloses the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle (Column 4, lines 56-66).

With respect to claim 24, Kubby discloses the bubble forming liquid and the ejectable liquid are of a common body of liquid (Column 1, lines 17-30).

With respect to claim 25, Kubby discloses a page-width printhead (Column 14-16).

With respect to claim 26, Kubby discloses each heater element is in the form of a cantilever beam (Column 1, line 66-67, i.e. suspending the heater chips).

With respect to claim 30, Kubby discloses each heater element has two opposite sides and is configured such that a said gas bubble formed by that heater element is

formed at both of said sides of that heater element (Column 1, lines 64-67; Column 2, lines 1-16; Column 4, lines 56-66).

With respect to claim 31, Kubby discloses the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element (Column 1, line 27, i.e. nucleation).

With respect to claim 32, Kubby discloses a structure that is formed by chemical vapor deposition (CVD), the nozzles being incorporated on the structure (Column 3, lines 31-35; Column 5, lines 41-49, i.e. conventional CMOS processing).

With respect to claim 34, Kubby discloses a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers (Fig. 1, elements 20 and 24) to one another (Column 1, lines 17-30).

With respect to claim 37, Kubby discloses each heater element is substantially covered by a conformal protective coating (Fig. 3, element Si_3N_4), the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless (Column 4, lines 38-43).

However, Kubby fails to disclose the heater element and electrodes are formed of the same material.

Moon discloses an ink jet printer head where "a heater portion 221 and the electrode portions 222 are typically made of a single material or of a same material" (paragraph 0036).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the heater and electrode portions disclosed by Moon in the printhead of Kubby. The motivation for doing so would have been "the process and cost of fabrication of an ink jet printer head according to the present invention can be reduced, and productivity can thereby be increased" (paragraph 0036).

2. Claims 4, 16, 17, 22, 35, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kubby (US 5,706,041) in view of Moon et al. (US 2002/0054191 A1) as applied to claims 1 and 19 above, and further in view of The Fabrication and Reliability Testing of Ti/TiN Heaters (DeMoor).

Kubby disclosed the claimed inventions with the exception of:

- the heater material is titanium nitride,
- each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50, and
- each heater element includes solid material and is configured for a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of a said drop.

DeMoor discloses:

- it is desirable to use a heater made of Ti/TiN in integrated MEMS systems (a thermal inkjet is such a system), because this material provides the advantages of CMOS fabrication (low cost and uniformity) in combination with a very high reliability (see conclusion),
- Ti has an atomic number of 22, and
- Each heater element includes solid material and is configured for a mass of less than 10 nanograms (Table 1 and Fabrication dimensions).

At the time the invention, it would have been obvious to one of ordinary skill in the art to use the Ti/TiN Heaters of DeMoor in the ink-jet printhead of Kubby. The motivation for doing so would have been to provide the advantages of CMOS fabrication (low cost and uniformity) in combination with a very high reliability Ti/TiN heater (Conclusion).

3. Claims 8 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kubby (US 5,706,041) in view of Moon et al. (US 2002/0054191 A1) as applied to claims 1 and 19 above, and further in view of Silverbrook (US 5,841,452).

Kubby disclosed the claimed inventions with the exception of each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater element to heat that heater element sufficiently to form a said bubble in the bubble forming liquid thereby to cause the ejection of a said drop.

Silverbrook discloses a thermal ink jet printer, which uses heater energy of 200 nJ to eject ink. Using this energy allows the power dissipation to be reduced without affecting print speed (Column 18, lines 15-18).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the teachings of Silverbrook in the ink-jet printhead of Kubby. The motivation for doing so would have been to reduce power dissipation without affecting print speed (Column 18, lines 15-18).

4. Claims 10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kubby (US 5,706,041) in view of Moon et al. (US 2002/0054191 A1) as applied to claims 1 and 19 above, and further in view of in view of Feinn et al. (US 6,543,879 B1).

Kubby disclosed the claimed inventions with the exception of area density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

Feinn discloses an ink jet print head having a nozzle density of at least 10,000 nozzles per square cm (see Abstract) in order to improve the resolution of the print head (Column 1, lines 53-67).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the teachings of Feinn in the ink-jet printhead of Kubby. The motivation for doing so would have been to improve the drop generation rate of the print head (Column 1, lines 53-61).

5. Claims 14 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kubby (US 5,706,041) in view of Moon et al. (US 2002/0054191 A1) as applied to claims 1 and 19 above, and further in view of Kashino et al. (US 5,534,898). Kubby disclosed the claimed inventions with the exception of a structure, which is less than 10 microns thick, the nozzles being incorporated on the structure. Kashino discloses that it is desirable to have a nozzle plate that is only several microns thick, in order to obtain adequate values of drop velocity, drop size and refilling frequency (Column 6, lines 34-42).

At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the teachings of Kashino in the ink-jet printhead of Kubby. The motivation for doing so would have been to obtain adequate values of drop velocity, drop size and refilling frequency (Column 6, lines 34-42).

Response to Arguments

Applicant's arguments filed 15 April 2008 have been fully considered but they are not persuasive. The applicant argues "Kubby specifically discloses that the polysilicon layers of the suspended portion 18 contain the heating element doped regions 20, 22, whereas the other layers of the suspended portion, which are not polysilicon, do not contain heating elements. Accordingly, there is no motivation for one of ordinary skill in the art from the disclosure of Kubby, either alone or in view of the other cited references, to use polysilicon layers in the suspended portion which do not have heating elements." However Kubby discloses a thermal ink-jet printhead where "Alternately, a

resistor could be formed at 20a to function as a heating element, while 20b could function as a thermistor to monitor the behavior of heating element 20a" (Column 4, lines 52-55). Therefore, Kubby in view of Moon meet the claimed limitations.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Manaka (JP 60-94374) discloses a thermal inkjet printer having a suspended portion (Fig. 4a, element 16a).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Geoffrey Mruk whose telephone number is (571)272-2810. The examiner can normally be reached on Monday-Friday 7:30am - 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/G. M./
Examiner, Art Unit 2853
6/18/2008

/STEPHEN D. MEIER/
Supervisory Patent Examiner, Art Unit 2853